Modeling a Public Hospital Outpatient Clinic in Peru Using Discrete Simulation

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ABSTRACT

The main objective of this study is to assess the quality of care at one of the most visited public hospital in Piura, Peru. Studies show a high dissatisfaction towards the service offered by public hospitals, mainly due to long waiting times. Discrete simulation was used to help quantify the impact of the different iniatiatives. After being validated through historical data and hospital personnel, the model was capable of measuring the outpatient clinic's service level and facilitated the identification of bottlenecks. The most critical medical specialties are Obstetrics, Internal medicine, and Gynecology, which have the longest queues. The results also help identify the services with a low utilization rate. High idle time at the insurance verification process was also found.

1. INTRODUCTION

Discrete event simulation has been used for a variety of health care applications (Jahn et.al. 2010). For example, it has been used to improve patient care in emergency departments (Abo-hamad, and Arisha, 2013; Brenner et.al., 2010; Cabrera et. al., 2012; Hoot et.al., 2008; Jamon and Lin, 2012), to model outpatient clinics (Al-Araidah et. al., 2012; Villamizar et.al., 2012), etc.

The simulation tool used in this study can help hospital management assess the service level through measuring queue length, waiting times, and utilization rates at the different health services.

2. SYSTEM DESCRIPTION

The hospital offers 25 medical specialties. In 2004, 67 957 patients were attended, while in 2010 this number increased to 107 202 outpatients. In six years, the number of attended patients duplicated; 30% of those patients had medical insurance, 60% did not, and the rest were exonerated of the payment due to their economic situation.

The outpatient clinic has 4 stages. First is admission. Second is the insurance module just for the patients with insurance, where they will receive the payment waiver. The third stage is the medical assessment itself. Finally, the last stage includes pharmacy, x-ray and laboratory tests. Throughout the process, patients experience long waiting times and queues.

3. SIMULATION MODEL

An extended survey was carried out in order to collect data on the arrival process, and the service times at the different stages. To represent the real process, process observation, database retrieval, interviews to doctors, and hospital employees, and time studies were conducted. The service process was modeled by a discrete event simulation, using Arena software.

3.1 INPUT ANALYSIS

Probability distribution was used to describe the time between arrivals and the services time.

Time between patients' arrivals was described by an exponential distribution. The receptionist's service time, at the admission area, varies according to the type of patient (with insurance or without insurance). An Erlang distribution describes the service time of the receptionist for patients with insurance, while a lognormal distribution for patients without insurance.

For the 15 medical specialties chosen to be modeled, and for pharmacy, x-ray, and lab tests time services, triangular distributions were used.

An external arrival to pharmacy, x-ray and lab coming from hospitalization and emergency room was also considered in the model. The time between external

arrivals in the pharmacy was described as a weibull distribution, while x-ray and laboratory external arrivals were described as uniform distributions.

3.2 MODEL

First, a small portion of the model was built, and after its functionality was established, more areas and complexity were added. Once the model was complete, its functionality was verified. After checking if the model does what is intended to, the model was also validated. At this stage, the amount of daily average patients treated was compared to the historical data. Meanwhile, other service indicators such as average time spent at the different queues and total average waiting time in the hospital were validated by the hospital personnel. It was concluded that the model is a credible representation of the real system.

4. CONCLUSIONS AND DISCUSSION

Discrete simulation is a tool for analyzing complex systems where there is a number of random variables involved. It can provide more understanding of the system, and hence take better decisions. This tool is perfectly applicable to the health sector. This study shows the use of this tool to a public hospital in Peru, showing good results.

The results give a better understanding of the current process at the clinic. They show that the most critical medical specialties are Obstetrics, Internal medicine, and Gynecology, which are the most utilized and have the longest patient queues. There is a need for increasing resources in these areas, especially at Obstetrics due to a high utilization rate: 100%.

The model also helped identify a high idle time at the insurance module. Also, a low utilization rate in pharmacy, lab, x-ray and admission area was found. Therefore, it seems adequate to integrate the insurance module tasks with the admission and the other services.

Some what-if scenario analysis was also performed. This analysis permits quantify the impact of possible solutions. By adding a second obstetrician, the service level improves drastically: the average waiting time for a patient can be reduced by 72% (from an average of 148.93 to 41.66 minutes in queue). It also shows that adding more staff level at admission or reception lab does not improve the service level at the outpatient clinic. More analysis to try different resource allocation and system configuration will be done in subsequently studies.

The model used in this study can be used for continuous improvement at the hospital, and also it can be easily adapted to any public hospital in Peru since the outpatient process is similar.

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